

The Framework of Cloud e-Learning System for Strengthening ICT Competence of Teachers in Nicaragua

Yong Kim[#]

[#]Department of e-Learning, Graduate School, Korea National Open University, Seoul, 03087, Korea
E-mail: dragonknou@gmail.com

Abstract— ICT use in education is a key instrument to enhance educational quality and change the educational paradigm. For example, Korea has been using computers and Internet into primary and secondary schools since the 1980s. There have been many educational policies for ICT use in education. Not only developed countries but also developing countries make a lot of effort to enhance the quality of education by using ICT in education. First of all, ICT competence of teachers is very important in order that ICT can be an effective tool in education. The level of teachers' ICT competence decides the level of using ICT in education. However, it is not easy for many teachers to take training for enhancing the level of ICT competence in a short time. This study suggests an e-learning system for strengthening the ICT competence of teachers by using an example of an educational environment in Nicaragua. Since this e-learning system can be operated by using cloud computing technology, it will provide implications for education projects with ICT use in primary and secondary schools in developing countries.

Keywords— e-learning; ICT use in education; learning system; Nicaragua

I. INTRODUCTION

According to the HDI (human development index) report, which was reported by UNDP in 2015, Nicaragua is ranked 125th in the world [1]. Nicaragua sets educational plans for developing human resources and executes educational policies. Nicaragua takes advantage of ODA (Official Development Assistance) from other countries. Nicaragua government tries to enhance educational quality through using by ICT and cultivate IT manpower through vocational education.

Using ICT in education is considered as an educational method to teach such core abilities for students of 21 centuries as critical thinking, communication, collaboration and creativity [2].

Beginning with computer education, Korea applies ICT use in education to primary and secondary education. There are wired and wireless Internet service and computers in schools of Korea. As of 2015, the number of students per computer is 3.7 students in primary schools, 3.8 students in middle schools and 3.2 students in high schools. In case of wireless service, schools with the Internet speed of over 100M are 72.9%, and every school provides 1Mbps speed of Internet [3].

Except for ICT infrastructure, the most necessary element for vitalizing using ICT in education in primary and secondary education in developing countries is strengthening

the ICT competence of teachers. However, it is very hard for teachers to take training in a short time due to limited space for training and their duties, for example, teaching students. Thus, the best way of enhancing ICT competence of many teachers in a short time without regard to place and time is introducing e-learning. Especially, a cloud e-learning system is cost effective. Based on educational environments of Nicaragua, this study provides an e-learning system for strengthening the ICT competence of teachers in primary and secondary schools. It will suggest implications for vitalizing ICT education in developing countries.

II. MATERIAL AND METHOD

A. Cloud Computing and e-Learning System

From the viewpoint of educational use of ICT in Korea, the cloud computing includes Internet-based applications and every h/w and s/w inside of a cloud computing system [4].

The main advantages of cloud computing technology are as follows [5], [6].

- Initial purchasing cost and expenses are low, and available rate of computers is high.
- It is possible to use various devices as terminal units, and it is possible to realize consistent user environment through service.
- User data can be kept in a safe server with high credibility.

- It is easy to use without professional knowledge about hardware.

There are ongoing studies which apply these cloud computing technologies to education.

According to the study of a developing learning model based on cloud computing, unlike existing website, the cloud computing is a supporting computing system of the user in a virtual space. The cloud computing technology helps positive interactions of learners through cooperative learning and produces effective and creative outcomes [7]-[10].

The study of applying cloud computing technology to e-learning suggests the efficiency of e-learning operation and effective learners customized service when LMS (Learning Management System) and LCMS (Learning Content Management System) meet cloud environment based on convenience and efficiency [11], [12].

There is also an ongoing study which supports various user environments by applying cloud computing technology from the learner's side [13].

B. ICT Use in Education

There are two approaches to ICT use in education. One is ICT literacy which teaches the ability to use ICT including computer, application s/w, and the Internet. The other is applying to teaching-learning by ICT such as computers and Internet [14]. ICT literacy of students and teachers should be fundamental in order to apply ICT into education. Thus ICT literacy has to be preceded to use ICT in teaching-learning.

The result of meta-analysis comes from articles which have been published after 2000 in Korea. The result is about the influence of ICT use teaching and learning on academic achievement. The result demonstrates that about 85% of analyzing targets shows that ICT use teaching and learning has rather clear effect than traditional teaching and learning in term of academic achievement [15].

There have been discussions on effective teaching of combining ICT with academic writing or math teaching not only in primary and secondary education but also in higher education [16]-[18]. There have been increased cases using ICT in higher education in the area of academic business from registration to graduation [19].

The ICT competence of teacher is an important element for the effectiveness of ICT use in education. UNESCO proposes standards of ICT competence of teachers and recommends them to use in teachers' training [20]. Korea also proposed ISST (ICT Skill Standard for Teacher) and ISSS (ICT Skill Standard for Student) in education [3], [21]. They provide such basic competences as collecting, processing and delivering information for obtaining and using information at information-oriented society.

Korea also ranks 2nd on digital skills in the world. The target of the survey is 15 years old students living in the urban area of 31 OECD countries [22]. It shows the achievement of ICT use in education in Korea.

We conducted following processes for suggesting an e-learning system model which is customized to the educational environment of Nicaragua. First, the status of present conditions in education is analyzed with literature analysis. Second, the interview with education officials in educational institutions is conducted for analyzing educational environment of Nicaragua. Such institutions

related to primary and secondary education as Ministry of Education, Ministry of Youth and INATEC (Instituto Nacional Tecnológico) are on a visiting list. Third, visiting schools is done with interviewing teachers including principal and checking facilities for ICT use in education. Finally, the e-learning system model is introduced for strengthening the ICT competence of teachers in primary and secondary schools and validity verification is done by feedback from stakeholders.

Four Korean educational specialists and 35 educational officials of Nicaragua participated in this process for 2 weeks.

III. RESULT AND DISCUSSION

A. Analysis of Educational Institutions

The Ministry of Education conducts ICT related project in secondary schools for ICT use education at primary and secondary education. They set up a goal which 100 secondary schools (10% of entire schools) have an Internet connection by 2016. As of February 2016, there are 37 secondary schools with an Internet connection.

Unlike an urban area, it is planned to connect Internet by using a satellite in a rural area. The Internet in schools will be connected to WiFi for using mobile devices and PC.

According to a UNESCO report, such ICT environment as electricity, computer supply, and connecting Internet in the educational environment of Nicaragua is in poor condition comparing to other countries in South and Central America [23]. However on-site visiting and interviewing with teachers show that ICT literacy skill of teachers is good. It is because there is a teacher training program for making android OS-based educational application to use on a tablet PC.

INATEC is responsible for the vocational training of youth, family and the local community. The main tasks of INATEC are revitalizing vocational training centers of local community and enhancing technical ability. The target number of producing trainee as of 2014 is more than about 300,000 teachers, and they are providing technical training, English education, teacher training, vocational training, and entrepreneurship education.

The main functions of INATEC are establishing and conducting vocational training programs according to the needs of the industrial and national development project, developing teacher training programs cooperating with domestic and foreign universities, establishing training strategies at the national level and defining a national model of technical training.

INATEC has provided national standards of technical and vocational training for enhancing the quality of teachers since 2013 and is planning to begin strengthening the competence of teachers from 2016.

The Ministry of Youth was established in 2013 and tasks of Youth Institute (INJUVE) was transferred. The Ministry of Youth is in charge of recreation, culture, education, health, entrepreneurship spirit and youth participation.

During the interview, the officials at the Ministry of Youth express opinions that there should be schools for computer and language education in 69 regions.

B. Interviews with Educational Officials

The Ministry of Education, Nicaragua, reviewed problems and improvement plan of education in the 1st educational strategic plan from 2011 to 2016. Especially there have been investigations on the ICT necessity at schools. The target countries of these investigations are countries in Central and South America which educational culture is similar to Nicaragua culture. Based on them the 2nd educational strategic plan from 2017 to 2021 are planned and executed. The Ministry of Education, Nicaragua, plans to connect the Internet at 799 schools (out of 1,000 schools) which about 80% of entire secondary schools. The Ministry of Education, Nicaragua, also has a plan to execute training programs related to ICT use for 10,000 teachers in secondary schools.

Thus in the new education strategy establishment of ICT training institutions or development of such training programs as the e-learning is suggested for strengthening the ICT competence of teachers and using ICT in class. The necessity of a training system based on e-learning is suggested for training many teachers in a short time. However, considering poor ICT infrastructure of Nicaragua the training system of blended learning which combines traditional training and e-learning needs to be considered. According to the investigation, various training contents should be provided in e-learning system for enhancing the effectiveness of the training.

The cause of hindrance to applying ICT to school education are investigated during interviews with teachers. The results are as followings:

TABLE I
THE CAUSE OF HINDRANCE TO USE ICT IN EDUCATION

Rank	Cause
1	Lack of computer & Internet
2	Lack of educational materials for teaching
3	Lack of teacher training program
4	Lack of technical support/technicians
5	Lack of computer literacy/skills of teachers & students
6	Lack of S/W to be able to make educational materials

The 1st cause of hindrance which is picked by teachers is 'lack of computer & Internet'. It is not easy to solve in a short period of time, but the 2nd educational strategy of Nicaragua will provide the solution. The 2nd cause of hindrance is 'lack of educational materials for teaching'. And such causes as 'lack of teacher training program', 'lack of technical support/technicians', 'lack of computer literacy/skills of teachers & students', and 'lack of s/w to be able to make educational materials' are following.

Teachers strongly requested educational resources for teaching and learning and such training as e-learning for using ICT in education. This proves that e-learning system for strengthening the ICT competence of teachers should include not only online training program but also various teaching and learning materials.

C. e-Learning System Framework

The e-learning system for strengthening the ICT competence of teachers of Nicaragua should consider

following roles. They are based on investigations on educational institutions of Nicaragua and interviews with educational officials.

First, the e-learning system should be commonly shared by teacher training institutions all over the country in order to have effective information sharing and online training.

Second, it should provide not only online training but also various digital contents for teaching and learning in class.

Third, it should provide space for communication for sharing information among teachers.

Forth, it should provide easy accessibility to the system and supplementation of a system for online training.

Based on the above-mentioned roles the e-learning system framework which is discussed with educational officials of Nicaragua is shown on Fig. 1.

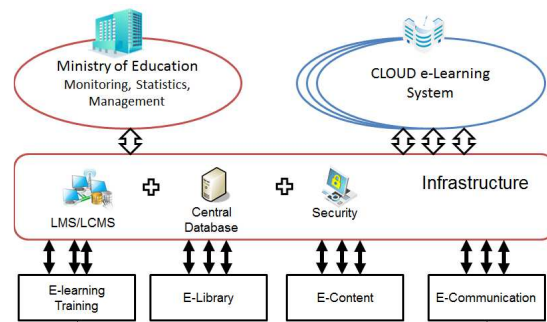


Fig. 1 e-learning system framework

It provides an infrastructure which can operate e-learning training through a cloud computing based e-learning system. Each regional teacher training institution uses the e-learning system together and shares not only administrative support for the teacher training but also necessary training information. It also has such advantages as co-development of e-learning courses and sharing materials of teacher training and sharing information.

Especially the effectiveness of training and results of teacher training process should be recorded in the learning management system. Functional design should be considered from the side of training operator and teacher, too. The self-evaluation items for enhancing the quality of the learning management system which is necessary for effective e-learning training are suggested as follows.

TABLE II
THE SELF EVALUATION ITEMS

Domain	Detained Domain	Explanation
S/W support	Operation environments	It is necessary to consider such elements as operating system, database, developing language, a web browser which are necessary for LMS. e.g.1) Are they using an operating system which client and server environments are verified? (E.g. Unix, Windows, Linux, MacOS, etc.) e.g.2) Does LMS use or support

		a verified standard web browser? (E.g. Chrome, MS Explorer, etc.)
	Plug-in support	It is necessary to consider an item (E.g., Flash S/W, etc.) of separate installing for the effective online learning by using LMS. e.g.1) Do Plug-in programs and LMS of web browser run stably and interactively? e.g.2) Is it possible to modify the error solution by updating a patch program of the plug-in?
	Standard compliance	It is necessary to consider such standard technologies of LMS as SCORM, Metadata.
	UI	It is necessary to consider whether user-oriented interface consists or not. E.g.) Does LMS have a consistent menu?
Operation Support	User management	It is necessary to consider management functions of users who use LMS. e.g.1) Is it possible to change or limit of manager's (operator's) right (functions)? e.g.2) Is a security measure for the protection of personal information provided? e.g.3) Is there a setting which only registered user can input or change his or her personal information?
	Solution management	It is necessary to consider management functions of LMS for operating the effective online learning. e.g.1) Is it possible to upload and download various materials (E.g., various documents, pictures, and videos, etc.) within solution? e.g.2) Is it possible to input and output materials (contents, learners' information) to LMS and LCMS? e.g.3) Does LMS provides synchronous or asynchronous tools for operating online learning (E.g., messenger, video lecturing, etc.)?
	Statistics support	It is necessary to consider the functions of LMS for learning analysis by producing various statistics. e.g.1) Are various statistics for representing learning level (E.g., group level, personal level, and average level, etc.) provided? e.g.2) Are various statistics for representing learning activities (E.g., progress, learning time and data, etc.) provided? e.g.3) Is it possible to inquiry and extract statistics according to designation variables (e.g., duration, time and user)?

	Course offering & introducing	It is necessary to consider the functions of course offering and course introducing of operating online learning. e.g.1) Is it possible to make a syllabus of the online course (e.g., title, of course, goal, of course, teacher's information, schedule, test plan and information on subject, etc.) e.g.2) Can teacher (or learner) make various documents on schedule for online learning (e.g., learning schedule, etc.)?
	Course registration	It is necessary to consider the various functions for registering courses of online learning. e.g.1) Is it possible to check a syllabus and preview the course (or subject) before course registration? e.g.2) Is it possible to check information in-detail on the course (or subject) in progress?
Teaching - learning activity support	Content registration	It is necessary to consider the supporting functions for teachers and learners by using LMS in case of operating e-learning. e.g.1) Are developed contents with various types (E.g., video, HTML, H5P, etc.) supported to register? e.g.2) Are various instructional techniques (E.g., minimum learning time, progress in order, elective progress, etc.) supported? e.g.3) Is it possible to input and save metadata on learning contents and additional materials?
	Content access	It is necessary to consider the functions for accessing to learning content within LMS. e.g.1) Is streaming service of video contents provided? e.g.2) Are various functions for protecting copyright (E.g., no use of the right button of the mouse, no exposure of absolute path, etc.) provided?
	Data creation among teaching - learning	It is necessary to consider the functions of data produced by teachers and learners. e.g.1) Can teachers provide feedback on submitted works and data to learners? e.g.2) Is it possible to confirm the version (or date) or author of LMS created data? e.g.3) Is it possible to upload created data without system error?
	Teaching support	It is necessary to consider the functions for supporting teacher activities within LMS. e.g.1) Are there functions which teacher can designate an

		<p>assistant who has some rights entrusted by the teacher?</p> <p>e.g.2) Can teacher read necessary information and learning background of the learner for the course (or subject) (except personal information)?</p> <p>e.g.3) Are various study encouragement functions (E.g., email, SMS, 1:1 message, etc.) provided?</p>
Learning management	Learning progress management	<p>It is necessary to consider the functions which figure out learning the progress of learners.</p> <p>e.g.1) Can learner read records of attendance and learning progress?</p> <p>e.g.2) Can learner check and compare average progress and personal progress of the same course (or subject)?</p> <p>e.g.3) Can personal records and grade be kept without losing in case of unusual discontinuing of the learning?</p>
	Learning activity management	<p>It is necessary to consider the functions which promote teaching and learning activities.</p> <p>e.g.1) Can learning activities be recorded and read?</p> <p>e.g.2) Is an editing function on learning activities (e.g., test, homework, etc.) provided?</p>
	Test management	<p>It is necessary to consider the functions of entire evaluations which are related to test while online learning activities.</p> <p>e.g.1) Are various test items (E.g., right or wrong type, multiple choice, short answer question and essay type, etc.) provided?</p> <p>e.g.2) Is it possible to provide such feedback as an explanation of each item and the exam paper?</p> <p>e.g.3) Is it possible to grade some questions automatically (E.g., right or wrong type, multiple choice, and short answer question, etc.) after the online test?</p>
Community Management	Community support	<p>It is necessary to consider the functions of various communities for supporting extra activities.</p> <p>e.g.1) Are various community functions related to learning activities (e.g., email, 1:1 message, chatting, messenger, bulletin board and blog, etc.) provided?</p> <p>e.g.2) Is it possible to connect and operate with an external independent community system (e.g., Facebook, etc.)?</p>
	Bulletin board management	<p>It is necessary to consider functions of various bulletin boards for supporting online learning.</p>

		<p>e.g.1) Is it possible to open and operate a bulletin board per user group (E.g., teacher, learner, other users)?</p> <p>e.g.2) Is basic information on bulletin board users (e.g., writer, date of writing, etc.) provided?</p>
Summative evaluation management	Summative evaluation	<p>It is necessary to consider entire functions which are related to final evaluation results on online learning.</p> <p>e.g.1) Can a learner inquiry into the result of summative evaluation?</p> <p>e.g.2) Can a teacher set evaluation items and ratio?</p>
Additional service support	Additional services	<p>It is necessary to consider the functions for supporting additional services.</p> <p>e.g.) Is it possible to inquire into lecturing (or teaching) background in the past?</p>

In case of developing LMS “S/W support”, “operation support”, “teaching-learning activity support”, “learning management”, “community management”, “summative evaluation management” and “additional service support” should be considered. The “S/W support” is about supporting various software for LMS operation. There are such domains as “operation environments”, “plug-in support”, “standard compliance” and “UI” in the area of “S/W support”.

The “operation support” is about basic functions for operating teaching and learning through the LMS.

The “teaching-learning activity support” is about the functions of supporting teachers and learners in case of operating e-learning through the LMS.

The “learning management” is about the LMS functions which support and control learning contents and activities of the learner.

The “community management” is about community functions of the LMS or an external community for supporting learners and teachers of e-learning operation.

The “summative evaluation management” is about functions which control learning evaluation and results of the learner.

The “additional service support” is about the functions of an effective operation except for fundamental supporting functions of the LMS.

IV. CONCLUSION

The investigation shows that ICT use in education in Nicaragua is conducted not only in such regular education as primary and secondary education but also in vocational education. The government of Nicaragua designates Ministry of Education, Ministry of Youth and INATEC as management departments and conducts ICT use in education.

This study discusses strengthening the competence of teachers for using ICT in education. This is conducted by visiting educational institutions and interviewing educational officials. As a result, it is necessary to introduce e-learning system for effectively strengthening teachers’ competence of

using ICT in education. The cloud-based e-learning system framework is suggested.

The suggestions of developing and operating e-learning system for enhancing use ICT in the education of primary and secondary education and strengthening teachers' competence in Nicaragua are as followings:

First, it is necessary to improve the environment of teacher training institutions and introduce e-learning system. Nicaragua operates teacher training institutions for strengthening teachers' competence. It is necessary to have ICT equipment for improving the environment of teacher training institutions. It is also necessary to introduce e-learning system, and teacher training can be opened at any time and anywhere. In addition, the training system should be considered various methods such as intelligent tutoring system for effective training and management [24]-[27].

Second, it is necessary to develop programs of teacher training. The customized teacher training programs of ICT for educational environments of Nicaragua need to be developed. Such various methods as online and offline training programs should be provided. Especially it is necessary to provide teaching and learning models and teaching guide of each subject using ICT which utilizes such various ICT devices as a portable tablet PC at schools.

Third, it is necessary to share educational materials and information. It is necessary to have the could computing based on e-learning system which is able to share various materials and updated information for teaching and learning.

REFERENCES

- [1] UNDP, "Work for Human Development," One United Nations Plaza, Human Development Report 2015, 2015.
- [2] P21, *21st Century Student Outcomes*, P21 Partnership for 21st Century Learning, 2015.
- [3] Ministry of Education, White Paper on ICT in Education Korea 2015, DaeGu, Korea: Korea Education & Research Information Service, 2016.
- [4] KERIS, "Cloud computing for smart education," DaeGu, Korea, KERIS ISSUE Report RM 11-22, 2011.
- [5] B. Sosinsky, *Cloud Computing Bible*, Wiley Publishing, Inc. 2011.
- [6] K. Elleithy, T. Sobh, M. Iskander, V. Kapila, M. A. Karim, and A. Mahmood, *Technological Developments in Networking, Education and Automation*, Springer, 2010.
- [7] K. B. Park, "The Principle and Structure Design of Cloud Computing based Cooperative Learning in Social Studies," *Social studies education*, vol. 54, pp. 47-62, Mar. 2015.
- [8] D. W. Denton, "Enhancing Instruction Through Constructivism, Cooperative Learning, and Cloud Computing," *TechTrends*, vol. 56, pp. 34-41, Jul. 2012.
- [9] B. V. P. Kumar, S. Kommareddy, and N. U. Rani, "Effective Ways Cloud Computing Can Contribute To Education Success," vol. 4, pp. 17-32, Jul. 2013.
- [10] S. Stein, J. Ware, J. Laboy, and H. E. Schaffer, "Improving K-12 pedagogy via a Cloud designed for education," *International Journal of Information Management*, vol. 33, pp. 235- 241, Feb. 2013.
- [11] H. Y. Jeong, E. W. Kim, and B. H. Hong, "A Study on the Application of the LMS and LCMS Based E-Learning in the Cloud Computing Environment," *The Institute of Electronics Engineers of Korea*, vol. 47, pp. 56-60, Mar. 2010.
- [12] H. Y. Jeong and B. H. Hong, "E-learning Service Framework for Cloud Computing Environment," *Journal of Korean Institute of Information Technology*, vol.11, pp.153-159, Nov. 2013.
- [13] D. H. Kim, J. S. Kum, and C. S. Lee, "Web-based cloud model that can support multi-party e-learning content development platform," *The Korea Knowledge Information Technology Society*, vol. 9, pp. 115-124, Feb. 2014
- [14] MEHRD, *Guideline for ICT use in Primary & Secondary Education*, MEHRD, 2005.
- [15] B. D. Ku, "A Meta-Analysis on the Effects of Academic Achievement Using ICT Teaching-Learning: Focused on Theses and Journal Paper in Korea since 2000," *Korean association of computer education*, vol.17, pp.53-68, 2014.
- [16] A. A. Patak, H. A. Naim, and R. Hidayat, "Taking Mendeley as Multimedia-based Application in Academic Writing," *International Journal on Advanced Science, Engineering and Information Technology*, vol. 6, pp.557-560, 2016.
- [17] N. Bakri, T. S. Salleh, and Z. M. Zin, "Designing an Integrated Teaching and Learning of Mathematics and Image Processing in Engineering Technology," *International Journal on Advanced Science, Engineering and Information Technology*, vol. 6, pp.548-552, 2016.
- [18] H. Durani and N. Bhatt, "Cloud Computing in Higher Education: Gujarat State," *International Journal of Advanced Research in Computer Science and Software Engineering*, vol. 5, pp. 1-4, Jun. 2015.
- [19] D. Sulisworo, Tawar, and U. Ahdian, "ICT Based Information Flows and Supply Chain in Integrating Academic Business Process," *International Journal on Advanced Science, Engineering and Information Technology*, vol. 2, pp. 454-458, 2012.
- [20] UNESCO, *ICT Competency Standards for Teachers*, UNESCO, 2008.
- [21] J. Lee, Y. A Kim, and Y. K. Seo, "A Study on detailed Curriculum and standardization of ICT Competency for Teacher," Korea Education & Research Information Service, 2002.
- [22] OECD, "Student, Computer and Learning: Making The Connection", OECD, Sep. 2015.
- [23] UNESCO, "ICT in Education in Latin America and The Caribbean", UNESCO, 2012.
- [24] D. Hooshyar, R. B. Ahmad, M. Yousefi, M. Fathia, S. J. Horng, and H. S. Lim, "Applying an online game-based formative assessment in a flowchart-based Intelligent tutoring system for improving problem-solving skills," *Computers & Education*, Vol.94, pp.18-36. 2016.
- [25] D. Hooshyar, R. B. Ahmad, M. Yousefi, M. Fathia, S. J. Horng, and H. S. Lim, "SITS: a solution-based intelligent tutoring system for students' acquisition of problem-solving skills in computer programming," *Innovations in Education and Teaching International*, pp.1-11, 2016.
- [26] D. Hooshyar, R. B. Ahmad, M. Yousefi, M. Fathia, A. Abdollahi, S. J. Horng, and H. S. Lim, "A solution-based intelligent tutoring system integrated with an online game-based formative assessment: development and evaluation," *Educational Technology Research and Development*, vol. 64 no.4, pp.787-808, 2016.
- [27] D. Hooshyar, R. B. Ahmad, M. Yousefi, F. D. Yusop, and S. J. Horng, "A flowchart - based intelligent tutoring system for improving problem - solving skills of novice programmers," *Journal of Computer Assisted Learning*, vol.31 no.4, pp.345-361, 2015.